CLAIMS:

1. A diamond wafer assembly for use in a method of processing single crystal diamond substrates, comprising a plurality of single crystal diamond plates fixed to a support layer in a substantially planar arrangement such that at least one of the major surfaces of the respective fixed single crystal diamond plates defines a fabrication surface that is exposed for further processing.

2. A diamond wafer assembly according to claim 1, wherein only one of the major surfaces of the respective fixed single crystal diamond plates is exposed for further processing, the support layer forming a backing layer for the fixed single crystal diamond plates opposite the respective fabrication surfaces.

3. A diamond wafer assembly according to claim 1, wherein both of the major surfaces of the respective fixed single crystal diamond plates are exposed for further processing, the support layer extending between the respective single crystal diamond plates.

4. A diamond wafer assembly according to any one of the preceding claims, wherein the single crystal diamond plates are CVD diamond plates.

5. A diamond wafer assembly according to any one of the preceding claims, wherein the single crystal diamond plates are arranged in a predetermined array.

6. A diamond wafer assembly according to claim 1, wherein the predetermined array is regular and based on a two dimensional array of lattice points with one or more plates associated with each lattice point.

7. A diamond wafer assembly according to any one of the preceding claims, wherein the diamond wafer assembly is suitable for automatic wafer handling equipment and provides an orientation feature which is machine readable and provides orientation of the diamond wafer assembly about its normal axis within certain limits.

8. A diamond wafer assembly according claim 7, wherein the machine readable orientation feature enables orientation to be achieved within a spread of 5°.

9. A diamond wafer assembly according to any one of the preceding claims, wherein the respective fabrication surfaces fall within a defined tolerance of a single conceptual plane.

10. A diamond wafer assembly according to claim 9, wherein the tolerance of the respective fabrication surfaces to the conceptual plane is less than about 100 µm.

11. A diamond wafer assembly according to claim 10, wherein the tolerance of the respective fabrication surfaces to the conceptual plane is less than about 10 µm.

12. A diamond wafer assembly according to claim 11, wherein the tolerance of the respective fabrication surfaces to the conceptual plane is less than about 5 µm.

13. A diamond wafer assembly according to claim 12, wherein the tolerance of the respective fabrication surfaces to the conceptual plane is less than about 3 µm.

14. A diamond wafer assembly according to claim 13, wherein the tolerance of the respective fabrication surfaces to the conceptual plane is less than about 1 µm.

15. A diamond wafer assembly according to claim 14, wherein the tolerance of the respective fabrication surfaces to the conceptual plane is less than about 0.2 μm.

16. A diamond wafer assembly according to any one of the preceding claims, wherein the single crystal diamond plates are arranged to butt together in a well-aligned array.

17. A diamond wafer assembly according to any one of claims 1 to 15, wherein the single crystal diamond plates are arranged in a well-aligned array and spaced from one another by a predetermined spacing.

18. A diamond wafer assembly according to claim 17, wherein the support layer comprises a backing layer that extends into the spacing between the respective single crystal diamond plates so as to embed at least a portion of the single crystal diamond plates in the support layer.

19. A diamond wafer assembly according to any one of the preceding claims, wherein the support layer is a polycrystalline CVD diamond support layer.

20. A diamond wafer assembly according to any one of the preceding claims, wherein the single crystal diamond plates are arranged in a predetermined array and their physical alignment with respect to the wafer is within defined limits.

21. A diamond wafer assembly according to claim 20, wherein the physical orientation of the single crystal diamond plates parallel to the plane of the support layer lies within a spread of 10°.

22. A diamond wafer assembly according to claim 21, wherein the physical orientation of the single crystal diamond plates parallel to the plane of the support layer lies within a spread of 5°.

23. A diamond wafer assembly according to any one of claims 20 to 22, wherein the physical orientation of the single crystal diamond plates comprises alignment of fabrication faces of the plates with respect to the plane parallel to the surface of the backing layer to within a spread of 5°.

24. A diamond wafer assembly according to any one of the preceding claims, wherein the single crystal diamond plates are arranged in a predetermined array and their crystallographic alignment with respect to the wafer is within defined limits.

25. A diamond wafer assembly according to claim 24, wherein the crystallographic orientation of the single crystal diamond plates parallel to the plane of the support layer lies within a spread of 10°.

26. A diamond wafer assembly according to claim 25, wherein the crystallographic orientation of the single crystal diamond plates parallel to the plane of the support layer lies within a spread of 5°.

27. A diamond wafer assembly according to any one of claims 24 to 26, wherein the crystallographic orientation of the single crystal diamond plates comprises alignment of fabrication faces of the plates with respect to the plane parallel to the surface of the backing layer to within a spread of 5°.

28. A diamond wafer assembly according to any one of the preceding claims, wherein the single crystal diamond plates are bonded to the support layer by an adhesive means.

29. A diamond wafer assembly according to claim 28, wherein the single crystal diamond plates are bonded to the support layer by glue or a metal braze.

30. A diamond wafer assembly according to claim 28, wherein the single crystal diamond plates are bonded to the support layer by diamond-to-diamond bonding.

31. A diamond wafer assembly according to any one of claims 1 to 15 and 17 to 30, wherein the assembly can be separated into one or more single crystal diamond substrates in which the support layer has a greater area than the single crystal diamond substrate(s).

32. A diamond wafer assembly according to claim 31, wherein the single crystal diamond substrates attached to the support layer can be used in optical, thermal, mechanical or electronic applications, or combinations thereof.

33. A method of producing single crystal diamond substrates, the method including the steps of providing a plurality of single crystal diamond plates, each diamond plate having a pair of opposite major surfaces, one or both of the major surfaces defining a fabrication surface, fixing the diamond plates in a substantially planar array to a support layer to form a diamond wafer assembly, and processing as required the fabrication surfaces to produce respective single crystal diamond substrates.

34. A method according to claim 33, wherein the support layer is bonded to the single crystal diamond plates, collectively or individually.

35. A method according to claim 34, wherein the support layer is bonded to the single crystal diamond plates by adhesive means.

36. A method according to claim 35, wherein the support layer is glued or brazed to the single crystal diamond plates.

37. A method according to claim 34, wherein the support layer is bonded to the single crystal diamond plates by diamond-to-diamond bonding.

38. A method according to any one of claims 33 to 37, wherein the fabrication surfaces are processed to provide electronic or other device features on the single crystal diamond substrates.

39. A method according to claim 38, wherein the electronic or other device features are formed by lithographic techniques.

40. A method according to claim 38, wherein the electronic or other device features are formed by mechanical processing techniques.

41. A method according to any one of claims 33 to 40, wherein the support layer is formed as a backing layer for the respective single crystal diamond plates so as to expose only one of their major surfaces for further processing.

42. A method according to any one of claims 33 to 40, wherein the support layer is formed between the respective single crystal diamond plates so as to expose both of their major surfaces for further processing.

43. A method according to any one of claims 33 to 42, wherein the support layer is a polycrystalline CVD diamond support layer.

44. A method according to any one of claims 33 to 43, wherein the diamond wafer assembly is cleaved so as to produce individual single crystal diamond substrates or groups thereof.

45. A method according to claim 44,. wherein the diamond wafer assembly is cleaved in such a manner that the support layer remaining on individual substrates or groups thereof is complimentary in area to the individual substrate or groups thereof, respectively.

46. A method according to claim 44, wherein the diamond wafer assembly is cleaved in such a manner that the support layer remaining on individual substrates or groups thereof is larger in area than the individual substrate or groups thereof, respectively.

47. A method according to any one of claims 33 to 46, wherein each of the single crystal diamond plates has one or more minor surfaces that are prepared to provide crystallographic alignment of the plate with the support layer.

48. A method according to claim 47, wherein the one or more minor surfaces are brought into contact with detail on the support layer, or a temporary substrate used in the method, to provide crystallographic alignment of the plate with the support layer.

49. A processed diamond wafer assembly, comprising one or more processed single crystal diamond plates embedded in a polycrystalline diamond support layer or bonded to that layer by diamond to diamond bonding or another form of carbon only bonding, wherein the polycrystalline diamond support layer has a greater area than the one or more processed single crystal diamond plates.

50. A processed diamond wafer assembly according to claim 49, wherein the polycrystalline diamond support layer provides one or more of mechanical support, thermal heatsinking, electrical isolation, or enhanced electrical breakdown properties for the processed diamond wafer assembly.

51. A processed diamond wafer assembly according to claim 49 or claim 50, wherein the processed diamond wafer assembly is used in an application selected from optical, thermal, mechanical, electrical, electronic and combinations thereof.